

## CLAIMS

- 1 1. A method of converting a non-gaseous sample for accelerator mass spectrometry  
2 analysis, comprising:  
3 converting desired elements present in the non-gaseous sample to a predetermined  
4 gaseous form; and  
5 transporting the predetermined gaseous form to an accelerator mass spectrometer ion  
6 source.
- 1 2. The method of claim 1, wherein said step of converting comprises chemically reacting  
2 the non-gaseous sample.
- 1 3. The method of claim 2, wherein said step of chemically reacting comprises oxidizing  
2 the non-gaseous sample.
- 1 4. The method of claim 3, wherein said step of oxidizing comprises converting carbon in  
2 the sample to carbon dioxide.
- 1 5. The method of claim 2, wherein said step of chemically reacting comprises pyrolyzing  
2 the non-gaseous sample.
- 1 6. The method of claim 5, wherein said step of pyrolyzing comprises converting hydrogen  
2 in the sample to molecular hydrogen.
- 1 7. The method of claim 1, wherein prior to said step of converting, said method  
2 comprises:

3        depositing the non-gaseous sample on a solid substrate, and

4        desorbing the non-gaseous sample from said substrate.

1    8.        The method of claim 7, wherein said step of desorbing comprises irradiating the sample  
2    with a laser beam.

1    9.        The method of claim 7, wherein volatile components are removed from the sample  
2    subsequent to said step of depositing and prior to said step of desorbing.

1    10.       The method of claim 1, wherein prior to said step of converting, said method comprises  
2    nebulizing the sample.

1    11.       The method of claim 10, wherein said step of nebulizing comprises thermospraying the  
2    sample.

1    12.       The method of claim 10, wherein said step of nebulizing comprises electrospraying the  
2    sample.

1    13.       The method of claim 10, wherein said step of nebulizing comprises substantially  
2    removing volatile components from the sample.

1    14.       A method of converting a non-gaseous sample for analytical processing, said method  
2    comprising:

3        nebulizing the sample using electrospray;

4        converting desired elements present in the nebulized sample to a predetermined gaseous  
5    form; and

6 providing the predetermined gaseous form to an analytical processing device for  
7 analysis.

1 15. The method of claim 14, wherein the analytical processing device comprises an isotope  
2 ratio mass spectrometer.

1 16. The method of claim 14, wherein the analytical processing device comprises an  
2 accelerator mass spectrometer.

1 17. The method of claim 14, wherein said step of converting comprises directing at least a  
2 portion of the nebulized sample into a chemical reactor.

1 18. The method of claim 14, wherein prior to said step of nebulizing, said method  
2 comprises adding sub-micrometer sized particles to the non-gaseous sample.

1 19. The method of claim 18, wherein said sub-micrometer sized particles comprise silicon  
2 dioxide.

1 20. The method of claim 18, wherein said sub-micrometer sized particles comprise barium  
2 hexaaluminate.

1 21. A method of converting a non-gaseous sample for analytical processing, comprising:  
2 injecting the sample directly into a converter;  
3 converting desired elements present in the sample to a predetermined gaseous form; and  
4 providing the predetermined gaseous form to an analytical device for processing.

1 22. The method of claim 21, wherein the analytical processing device comprises an

2 accelerator mass spectrometer.

1 23. The method of claim 21, wherein the analytical processing device comprises an isotope  
2 ratio mass spectrometer.

1 24. The method of claim 21, wherein said step of converting comprises converting the  
2 hydrogen in the sample to molecular hydrogen.

1 25. The method of claim 21, wherein said converter comprises a pyrolyzer.

1 26. The method of claim 21, wherein said step of injecting comprises introducing the  
2 sample into the converter using a piezo-electric pipetter.

1 27. An interface for introducing a non-gaseous sample as a predetermined gaseous form into  
2 an accelerator mass spectrometer, said interface comprising:

3 a nebulizer that receives the non-gaseous sample to provide a fine spray of the sample;

4 a converter that receives at least a portion of said fine spray and converts the desired  
5 elements to the predetermined gaseous form; and

6 a flow line that transports the predetermined gaseous form to the accelerator mass  
7 spectrometer.

1 28. The interface of claim 27, wherein said nebulizer comprises an electrospray nebulizer.

1 29. The interface of claim 27, wherein said nebulizer comprises a thermospray nebulizer

1 30. The interface of claim 27, further comprising a chamber that couples said nebulizer to  
2 said converter, said chamber comprising means for reducing the flow of matter that does not  
3 contain analyte into said converter.

1 31. The interface of claim 30, wherein said chamber comprises a momentum separator.

1 32. The interface of claim 30 wherein said chamber comprises means for producing a beam  
2 of particles preferentially composed of analyte.

1 33. A sample processing interface for introducing a non-gaseous sample as a predetermined  
2 gaseous form into an analytical instrument, said interface comprising:

3 an electrospray nebulizer that receives the non-gaseous sample to provide a fine spray of  
4 the sample;

5 a converter that receives at least a portion of said fine spray and converts the desired  
6 elements in the spray to the predetermined gaseous form; and

7 a flow line that transports the predetermined gaseous form to the analytical instrument.

1 34. The interface of claim 33 wherein the analytical instrument comprises an accelerator  
2 mass spectrometer.

1 35. The interface of claim 33 wherein said converter comprises copper oxide.

1 36. A device for introducing a non-gaseous sample as a predetermined gaseous form into an  
2 analytical instrument, said device comprising:

3 an injector that receives the non-gaseous sample and provides a directed stream of the  
4 non-gaseous sample;

5 a converter that receives at least a portion of said directed stream and converts the desired  
6 elements to the predetermined gaseous form; and

7 a flow line that transports the predetermined gaseous form to the analytical instrument.

1 37. The device of claim 36, wherein said injector is configured and arranged to provide a  
2 drop diameter less than about 500  $\mu\text{m}$  and a sufficiently high drop velocity to permit droplets to  
3 travel a distance greater than about 1 cm in air.

1 38. The device of claim 37 wherein said injector comprises a piezoelectric pipetter.

1 39. The device of claim 36 wherein said converter comprises elemental carbon.

1 40. An interface for introducing a non-gaseous sample as a predetermined gaseous form into  
2 an accelerator mass spectrometer, said interface comprising:

3 a first stage that receives the non-gaseous sample and separates analyte from carrier  
4 material of the sample, to provide a separated sample stream that preferentially comprises the  
5 analyte; and

6 a second stage that receives said separated sample stream, converts the desired elements  
7 in said sample stream to the predetermined gaseous form, and transports the predetermined  
8 gaseous form along a flow line to the accelerator mass spectrometer.

1 41. The interface of claim 40, wherein said first stage comprises a nebulizer.

1 42. The interface of claim 40, wherein said first stage comprises means for desorption.

1 43. The interface of claim 42 wherein said means for desorption comprises a laser.

1 44. The interface of claim 40 wherein said second stage comprises an oxidizing reactor.